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Hairy Vetch as a Replacement for Synthetic Nitrogen

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Objectives

The purpose of this trial is to determine if hairy vetch (*Vicia villosa*) can supply the nitrogen needs for slicing cucumber (*Cucumis sativus*, cv. Diomede), fall squash (*Cucurbita pepo* cv. Royal Ace), pumpkin (*Cucurbita pepo* cv. Magic Wand), sweet potato (*Ipomea batatas*, cv. Covington), watermelon (*Citrullus lanatus* var. lanatus cv. Fascination), and zucchini (*Cucurbita pepo* cv. Paycheck).

Summary

In this study, hairy vetch proved to be a suitable nitrogen replacement for cucumber, watermelon, fall squash, sweet potato, and zucchini. Pumpkin could not be evaluated due to poor plant stands between and within treatments. In all species, hairy vetch gave similar yield and quality to bare ground and rye treatments, which received 80 pounds/acre nitrogen as polymer-coated urea (44-0-0). Hairy vetch alone had the highest biomass readings. Taking into account the cost of labor and materials for nutrient applications, using hairy vetch as the cover crop the previous August would have saved growers $26/acre in 2014.

Methods

Site Preparation

The chosen site had a volunteer rye crop established by disking in the existing mature rye cover crop in July 2013. Plots containing hairy vetch were established by drilling either 15 pounds per acre (hairy vetch + rye plots) or 25 pounds per acre (hairy vetch alone plots) of hairy vetch seed into the existing rye cover crop on 28 August, 2014. Hairy vetch alone plots were treated with Select Max on 28 September and 23 April to kill rye and other grass-type weeds. Bare ground plots were established by applying Roundup on 28 September and 23 April. On 23 April, 2,4-D was applied to rye only plots to kill hairy vetch and other broadleaf weeds. Biomass readings were taken for each plot on 28 to 30 May from randomly selected 0.25 square meter squares within each plot. Plots were rotary mowed 2 June, then plowed and disked.

Fertilizer

After disking and prior to dragging, bed shaping, and planting, 0-0-60, 95% sulfur, and Granubor were broadcast and incorporated across all plots at 200, 28, and 15 pounds/acre, respectively. Bare ground and rye only plots received 80 pounds/acre nitrogen as polymer-coated urea (44-0-0). No further nutrients were applied through the season. Soil samples were taken and analyzed after nutrient applications.

Weed Control

Weeds were controlled through cultivation and hoeing.

Planting
All species were planted 6 June. The sweet potato, cucumber, watermelon, and zucchini were placed on raised, plastic-mulched, drip-irrigated beds. Pumpkin and fall squash were planted on raised beds with drip irrigation but no plastic. Cucumber, pumpkin, fall squash, and zucchini were direct seeded, while watermelon and sweet potato were set as transplants. Sweet potatoes were planted 1 foot in the row; cucumbers, fall squash, and zucchini 2 feet in the row; pumpkins 4 feet in the row; and watermelon 6 feet in the row. Between-row spacing was 5.5 feet. Each plot was 35 feet long with the middle 25 feet being the harvested area.

Plant Care
Plots were irrigated as needed and insects and diseases controlled using recommended commercial practices.

Harvest and Data Collection
Plots were harvested at the suitable stage for that species and graded according to commercial standards and subjected to statistical analysis.

Results
The recommended rate of nitrogen for each of these crop species is 60 to 80 pounds per acre, while there are reports that hairy vetch can fix as high as 180 pounds of nitrogen per acre. Hairy vetch also fits into many Michigan vegetable and field crop rotations. In southwest Michigan, hairy vetch can be planted 1 August to 5 September. This time period is such that growers can harvest wheat, oats, and many early harvested vegetables prior to planting hairy vetch. Maximum nitrogen accumulation occurs at full bloom, which normally is mid- to late May, providing enough time to work the soil and plant other crops in late May or early June. One negative aspect of hairy vetch is that all seed will not germinate the year of planting and growers may find it a difficult weed to control in subsequent plantings.

Table 1. Biomass weights from four cover crop treatments at the Southwest Michigan Research and Extension Center, Benton Harbor, Michigan, in 2014.

Treatment	Pounds/Acre			
	Vetch	Rye	Other	Total
Bare Ground	10	0	32	42
Rye	504	3,607	500	4,108
Rye/Vetch	9,634	2,621	846	13,100
Vetch	20,225	731	864	21,820

Biomass values responded as expected with the bare ground (Roundup treated) plots averaging 42 pounds/acre total biomass as the lowest (Table 1). The vetch alone plots averaged the highest at 21,820 pounds/acre. The vetch only plots were substantially higher in biomass than rye and rye/vetch plots.

Soil analysis of the plots shortly after planting found similar values for all traits analyzed except for ammonium nitrogen levels which were elevated for the bare ground and rye plots, which received the 80 pounds/acre of 44-0-0 (Table 2). This was expected due to the addition of the 44-0-0.

Table 2. Soil analysis from four cover crop treatments at the Southwest Michigan Research and Extension Center, Benton Harbor, Michigan, in 2014. Samples were taken shortly after planting on 6 June, 2014.

Treatment	**pH**	**Lime Index**	**P** (ppm)	**K** (ppm)	**Ca** (ppm)	**Mg** (ppm)	**Nitrate-N** (ppm)	**Ammonium-N** (ppm)
Bare	6.5	71	115	144	367	67	4.6	24.4
Rye	6.0	71	122	161	378	65	3.0	25.0
Rye/Vetch	6.0	72	83	124	353	73	2.5	5.7
Vetch	6.0	71	110	142	365	70	2.8	7.6

Most research trials are conducted to determine the best treatment. In this trial, the desire was to hopefully see no difference between treatments. This was essentially the outcome (Table 3). No differences were noted in total yield for cucumber, watermelon, or sweet potato. Differences were found between some cover crop treatments in total yield of zucchini and fall squash. Some vegetable species evaluated also had differences in other traits (Tables 4, 5, 6, and 7). Stand for the pumpkin trial was not adequate for good evaluation.

Results of this research found that it is possible to replace synthetic nitrogen with nitrogen supplied by the hairy vetch cover crop. With the cost of the seed and nitrogen fertilizer used in this trial, using hairy vetch as the nitrogen source would have saved growers $26/acre.

Table 3. Total yield from five vegetable crops grown following four cover crop treatments at the Southwest Michigan Research and Extension Center in Benton Harbor, Michigan, in 2014. Numbers in bold are not significantly different than the top performer.

Treatment	**Cucumber** (1-1/9 bu/acre)	**Zucchini** (half bu/acre)	**Fall Squash** (bu/acre)	**Watermelon** (tons/acre)	**Sweet Potato** (cwt/acre)
Bare Ground	405	**1,440**	328	39.3	151
Rye	346	**1,251**	364	43.6	145
Rye/Vetch	132	982	310	31.6	122
Vetch	270	**1,251**	**543**	39.3	127
Lsd 0.05	**ns**	**290**	**132**	**ns**	**ns**

Table 4. Total yield, fruit number per acre, and mean fruit weight for Royal Ace fall squash grown following four cover crop treatments at the Southwest Michigan Research and Extension Center in Benton Harbor, Michigan, in 2014. Numbers in bold are not significantly different that the top performer.

Treatment	**Total Yield** (bu/acre)	**Fruit/Acre**	**Average Fruit Weight** (gms)
Bare Ground	328	10,930	683
Rye	364	11,246	742
Rye/Vetch	310	9,979	706
Vetch	**543**	**16,553**	747
Lsd 0.05	**132**	**4,127**	**ns**

Table 5. Total yield, fruit number per acre, and mean fruit weight for Fascination watermelon grown following four cover crop treatments at the Southwest Michigan Research and Extension Center in Benton Harbor, Michigan, in 2014. Numbers in bold are not significantly different than the top performer.

Treatment	**Total Yield** (tons/acre)	**Fruit/Acre**	**Average Fruit Wt.** (kg)
Bare Ground	39.3	6,098	5.7
Rye	43.6	5,861	**6.9**
Rye/Vetch	31.6	4,990	**5.8**
Vetch	40.6	6,732	5.4
Lsd 0.05	**ns**	**ns**	**1.1**

Table 6. Yield per acre and fruit quality for Paycheck zucchini following four cover crop treatments at the Southwest Michigan Research and Extension Center in Benton Harbor, Michigan, in 2014. Numbers in bold are not significantly different than the top performer.

Treatment	**Total Yield** (half bu/acre)	**Yield No. 1** (half bu/acre)	**Yield No. 2** (half bu/acre)	**Yield Cull** (half bu/acre)
Bare Ground	**1,440**	**761**	**630**	50
Rye	**1,251**	**710**	**491**	51
Rye/Vetch	982	612	324	46
Vetch	**1,251**	**722**	**468**	61
Lsd 0.05	**290**	**117**	**194**	**ns**

Table 7. Yield per acre and fruit quality for Diomede slicing cucumber following four cover crop treatments at the Southwest Michigan Research and Extension Center in Benton Harbor, Michigan, in 2014. Numbers in bold are not significantly different than the top performer.

Treatment	**Total Yield** (11/9 bu/acre)	**Yield No. 1** (11/9 bu/acre)	**Yield No. 2** (11/9 bu/acre)	**Yield Cull** (11/9 bu/acre)
Bare Ground	405	178	109	**118**
Rye	346	167	94	**85**
Rye/Vetch	132	85	12	35
Vetch	270	140	60	**70**
Lsd 0.05	**ns**	**ns**	**ns**	**60**

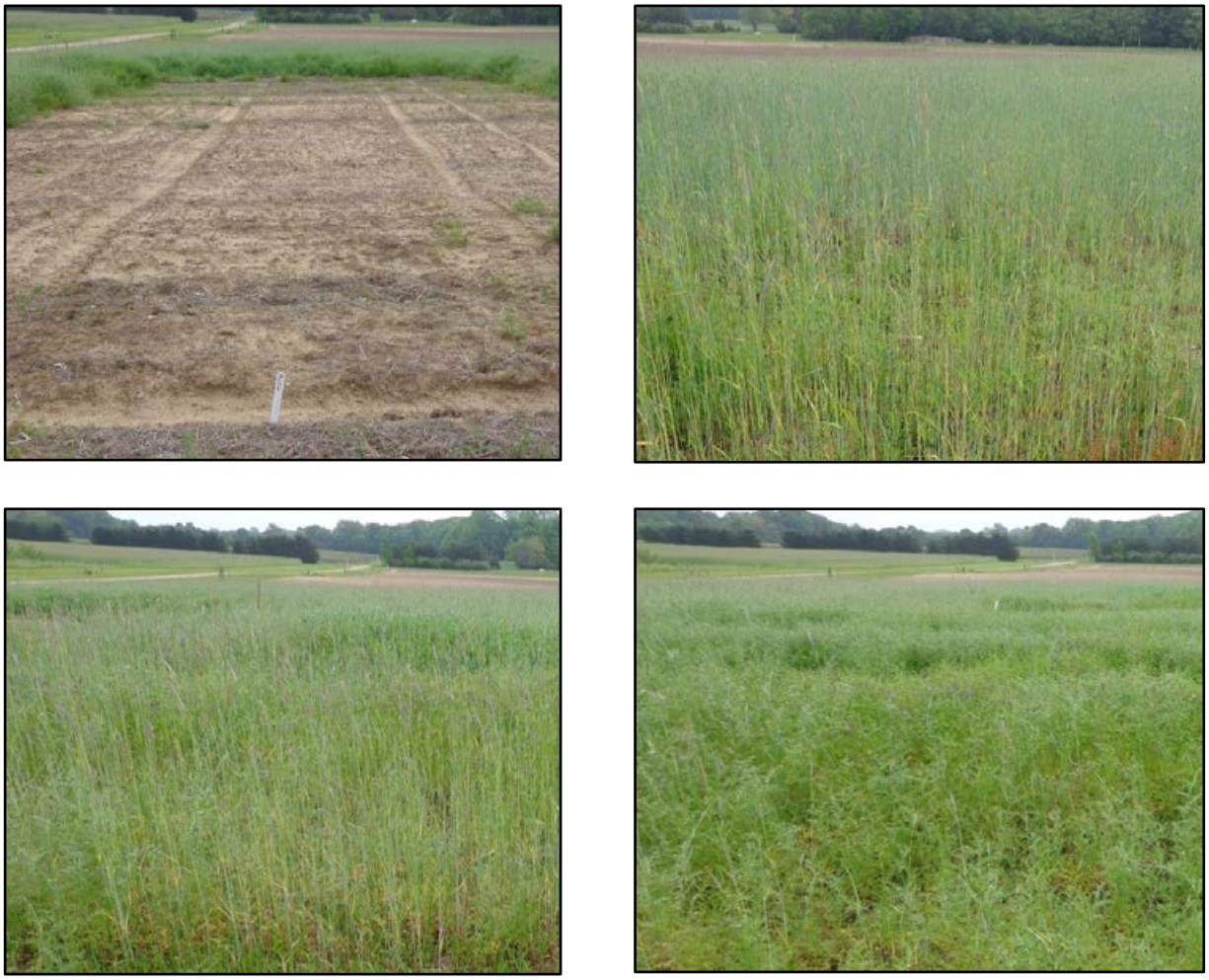

Figure 1. Four cover crop treatments at the Southwest Michigan Research and Extension Center, Benton Harbor on 28 May, 2014. Bare ground (upper left), rye (upper right), rye/hairy vetch (lower left), and hairy vetch (lower right).

Figure 2. Hairy vetch cover crop on 28 May 2014 at the Southwest Michigan Research and Extension Center Benton Harbor (top). Hairy vetch and rye cover crops (bottom) showing the root nodules on the hairy vetch.

Figure 3. Close up of a root nodule from hairy vetch with the pinkish color indicating active bacterial action at the Southwest Michigan Research and Extension Center, Benton Harbor, in 2014.

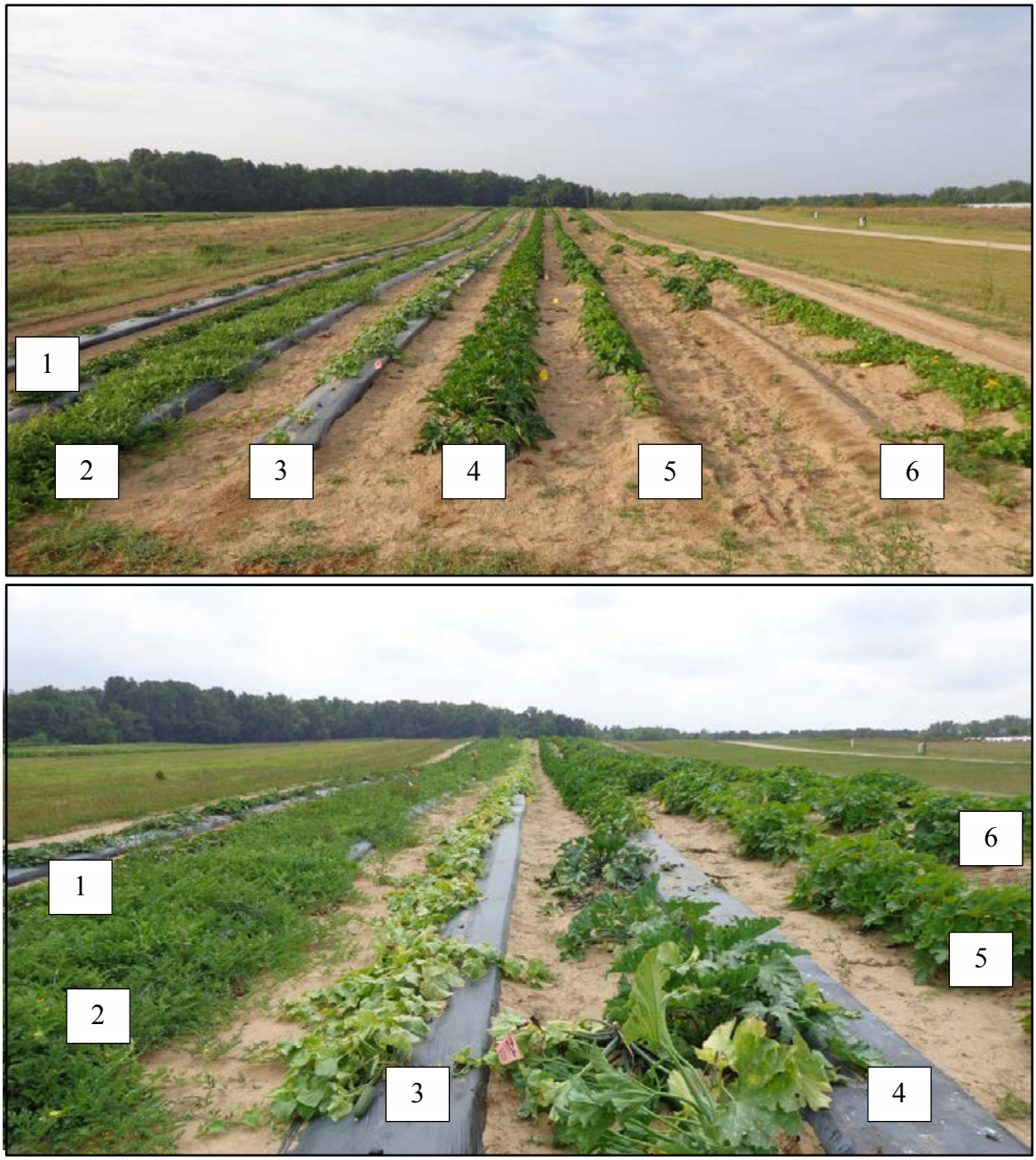

Figure 4. Growth of six vegetable crop species following four cover crop treatments at the Southwest Michigan Research and Extension Center. Sweet potato (1), watermelon (2), cucumber (3), zucchini (4), fall squash (5), and pumpkin (6). Outside rows are guard rows. Pictures taken 31 July (top) and 18 August (bottom). Zucchini plants have been recently cut since harvest was complete.